THE UPPER CAMBRIAN FAUNAS OF NORWAY

With Descriptions of Non-Olenid Invertebrate Fossils

BY

GUNNAR HENNINGSMOEN

(Paleontologisk Museum, Universitetet i Oslo).

CONTENTS

Introductions and acknowledgements

The Upper Cambrian fossils in Norway occur in the Olenid Series, a sequence of black bituminous shales (alum shales) with concretions and an occasional layer of black bituminous limestone (stinkstone). The shales crop out in various districts of the Oslo region and in the belt of larger Caledonian overthrusts in southern Norway. The alum shales were easily affected by tectonic disturbances and for this reason it is hard to give the exact thickness of the Olenid Series. It is probably no more than 60 m thick in the districts of the Oslo region where it is most completely developed.

The Olenid Series in Norway is divided into 6 zones. The upper 5 of these embrace 29 subzones, whereas the lowermost zone is undivided and also is the only unit not based on an olenid. The olenids are by far the most common fossils in this series as a whole, although where they occur, *Agnostus pisiformis*, *A. obesus*, and *Orusia lenticularis* may be as numerous as any of the olenid species, whereas other fossils are rare. In addition to invertebrate fossils, some algae-like structures have also been found.

The present paper includes descriptions of the few non-olenid trilobites and non-arthropod invertebrates known from the Olenid Series in Norway. For descriptions of the olenids, and for details on the Olenid Series, the reader is referred to an earlier paper (HENNINGSMOEN, 1957b). In that paper, there is, furthermore, a discussion on the correlation of the Upper Cambrian successions in the Acado-Baltic and North American provinces. In this connection the writer would like to point out that a trilobite, described by him (1957a) as *Taenicephalus*? *peregrinus* from the *Olenus* zone in Sweden apparently belongs to the genus *Pedinocephalus* IVSHIN 1956. This genus was described from an *Aphelaspis* fauna in Kazakhstan, which supports the view that the *Olenus* zone (or a part of it) may more or less be a correlative of the *Aphelaspis* zone.

The writer wishes to thank Dr. S. Skjeseth for placing at disposal some important material from the northern districts of the Oslo region. Furthermore, the writer is indepted to Miss B. Mauritz for taking the photographs and to Dr. W. C. Sweet for reading the manuscript.

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Description of fossils.

TRILOBITAE

Family Agnostidae McCoy 1849

Genus *Agnostus* Brongniart 1822

Type species: – *Entomolithus paradoxus γ pisiformis* Linnæus 1757, designated by Miller, 1889.

Agnostus (*Agnostus*) *pisiformis* Linnæus 1757

Pl. 5, figs. 1–12.

1757 *Entomolithus paradoxus γ pisiformis* – Linnæus, p. 122 (Short descr.)
1878 *Agnostus pisiformis*, Ang. – Brögger, p. 46, pl. VI, figs. 13a–b. (Rough figs. of cephalon and pygidium.)
1882 *Agnostus pisifomis*, Linné – Brögger, p. 55. (Remarks.)
1891 *Agnostus pisiformis* – Andersen, p. 20. (Recorded.)
1902 *Agnostus pisiformis* – Schiøtz, pp. 5, 63. (Recorded.)
1907 *Agnostus pisiformis*, Linn. – Holtedahl, p. 14. (Recorded.)
1922 *Agnostus pisiformis* (L.) – Westergård, p. 114, pl. I, figs. 1–3. (Remarks. Figs. of cephala and pygidium.)
1923 *Agnostus pisiformis* Linné – Poulsen, p. 21, pl. I, fig. 1. (Descr. and fig. of dorsal shield.)
1929 *Agnostus pisiformis* (L.) – Strand, p. 356. (Recorded.)
1934 *Agnostus pisiformis* – Størmer, p. 333. (Listed.)
1946 *Agnostus pisiformis* (Linnaeus, 1757) – Westergård, p. 85, pl. 13, figs. 10–14. (Remarks. Figs. of cephalon and pygidia.)
1947 *Agnostus pisiformis* – Westergård, p. 4. (Suppl. descr. in connection with descr. of A. *obesus*.)

For further synonyms, see Westergård (1922) and Poulsen (1923).
Non 1865 *Agnostus* Brongn. *pisiformis* Linné – Kjerulf (= *A. obesus*.)

Type data: – A type specimen should be chosen from Swedish material.

Remarks: – In some cases the ordinary smooth-cheeked cephala are associated with cephala with grooved cheeks, as also observed in Swedish material (Westergård, 1922). Where cephala with groved cheeks occur, some of the associated pygidia have pleural lobes which are reticulated or pitted. This ornamentation is most pronounced in smaller pygidia (pl. 5, figs. 7–8). Larval cranidia have a more elongate rectangular outline than the adult cranidia. The illustrated specimen (pl. 5, fig. 12) is the smallest seen in the present material. It measures 0.5 (length) × 0.4 mm (width).

I have not been able to detect in Norwegian material the subspecies *spiniger* (DALMAN 1828), which differs in having small but distinct cephalic spines.

Occurrence: – Norway: Brevik-Skien (Rognstrand core, Ombordsnes, Skriua), Sandsvær (Sandbakk core), Eiker (Krekling, Teigen core, Stablum core, Vestfossen), Oslo-Asker (Teigen at Øyeren), Ringerike (Hval, Viul), Hamar district (Stange, Stensrudbekken), Ringsaker (Evjevika, Steinsvika, Ringstrand, Mælum), Valdres-Vardal (Nerby near Gjøvik), Østerdalen (Kakeldå). – Zone of *Agnostus pisiformis* (2aα). Alone or associated with *Olenus alpha* and *Proceratopyge nathorsti*. – Sweden (same horizon and also in the upper part of the underlying Middle Cambrian zone of *Lejopyge laevigata*), Denmark, Great Britain?, Nova Zemlya, Canada.

Subgenus *Homagnostus* HOWELL 1935

Type species: – *Agnostus pisiformis* (LIN.) var. *obesus* BELT 1867, by original designation.

Agnostus (*Homagnostus*) *obesus* BELT 1867

Pl. 5, figs. 13–16.

1865 *Agnostus* BRONGN. *pisiformis* LINNÉ – KJERULF, p. 2. (Listed.)
1867 *Agnostus pisiformis*, LIN. var *obesus* – BELT, p. 295, pl. XII, figs. 4a–d. (Descr. and rough figs. of two dorsal shields.)
1878 *Agnostus* n. sp. – BRÖGGER, p. 62.
1880 *Agnostus pisiformis* var. *socialis* – TULLBERG, p. 25. (Descr.)
1882 *Agnostus pisiformis* LINN., var. *socialis*, TULLBERG – BRÖGGER, p. 56, pl. I, figs. 10a–b. (Descr. Figs. of cephalon and pygidium.)
1890 *Agnostus pisiformis* LINNÉ var. *socialis* TULLBERG – POMPECKI, p. 15, pl. IV, figs. 24, 24a–b. (Descr. Figs. of cephalon and pygidium.)
1898 *Agnostus pisiformis* var. *socialis* – BJØRLYKKE, p. 12. (Recorded.)
1901 *Agnostus pisiformis* v. *socialis* TULLB. – MÜNSTER, p. 24. (Recorded.)
1906 *Agnostus pisiformis* (L.), var. *obesus*, BELT – LAKE, p. 9, pl. I, figs. 13–14. (Descr. Figs. of 2 dorsal shields. *A. p. socialis* is claimed to be a synonym.)
1907 *Agnostus pisiformis*, LINN. var. *socialis* TULLB. – HOLTEDAHL, p. 14. (Recorded.)
1922 *Agnostus pisiformis obesus* BELT – WESTERGÅRD, p. 116, pl. I, figs. 4a–b. (Descr. Fig. of dorsal shield. According to WESTERGÅRD, 1947, figs. 5–6 are of *A. obesus laevis* WESTERGÅRD 1947.)
1923 *Agnostus pisiformis* LINNÉ var. *obesus* BELT – POULSEN, p. 22, pl. I, fig. 2. (Descr. copied from TULLBERG, 1880. Fig. of pygidium.)

1929 *Agnostus pisiformis obesus* BELT – STRAND, p. 356. (Recorded.)
1934 *Agnostus pisiformis obesus* – STØRMER, p. 333, (Listed.)
1935 *Homagnostus obesus* (BELT) – HOWELL, p. 15, figs. 11–12. (Erects *Homagnostus*. Figs. of cephalon and pygidium from Sweden.)
?1939 *Homagnostus* cf. *obesus* (BELT) – WHITEHOUSE, p. 261, pl. XXV, figs. 17, 18? (Figs. of cephalon and pygidium.)
1947 *Agnostus* (*Homagnostus*) *obesus* BELT – WESTERGÅRD, p. 3, pl. I. figs. 10–11. (Remarks. Figs. of cephalon and pygidium.)

Type data: – One of the specimens from the Lower Lingula Flags of Wales, figured by BELT (1867), should be chosen as lectotype.

Remarks: – The Norwegian specimens agree well with the British and Swedish material. The axis of the pygidium may vary from the typical tumid and wide type (pl. 5, fig. 14) to an almost *pisiformis*-like slender type. Some well-preserved Swedish specimens (pl. 5, figs. 15–16) show that the outer surface of the test is minutely punctate. I have found no specimens in Norwegian material of the subspecies *laevis* WESTERGÅRD 1947, which was described from the zone of *Parabolina spinulosa* in Sweden.

Occurrence: – Norway: Brevik area (Rognstrand core, Saltboden core), Sandsvær (Holmesli, Krogsrud), Eiker (Krekling, Stablum core, Teigen core), Oslo-Asker (Gamlebyen in Oslo, Teigen at Øyeren), Ringerike (Hval), Valdres-Vardal (N. Gausdal, Torpa, Tonsåsen), Ringsaker (Evjevika, Ringstrand, Båshus), Østerdalen (Toten). – Zone of *Olenus* and *Homagnostus obesus* (2aβ). Alone, or associated with *Olenus gibbosus*, *O. truncatus*, *O. wahlenbergi*, or *O. attenuatus* in their respective subzones.

BRÖGGER (1882, p. 56) stated that *A. pisiformis* var. *socialis* (= *A. obesus*) also occurs with *Parabolina spinulosa*. Most probably this statement is based on a find in Ekeberg-svingen, Gamlebyen in Oslo. The find consists of three pieces of stinkstone, kept in a box with a label from BRÖGGER's time. On this label is written the locality and "2b. *Agnostus pisiformis*, Linn. var. *socialis*, Tullberg med [=with] *parabolina spinulosa*, Wahl." Both species are present, but *Parabolina spinulosa* occurs alone in one piece of stinkstone which differs lithologically from the two other pieces with *A. obesus* only. The latter does not belong to the subspecies *laevis*, and it seems probable that samples from two different horizons have been mixed together.

– Sweden (same zone. Subspecies *laevis* in the overlying zone of *Parabolina spinulosa*), Denmark (same zone), Great Britain (same horizon), Australia?

Agnostus (*Homagnostus*) *rudis holmi* WESTERGÅRD 1922

1922 *Agnostus rudis Holmi* n. var. – WESTERGÅRD, p. 118, pl. I, figs. 13–16. (Descr. Figs. of cephala and pygidia.)
1939 *Agnostus rudis* var. *holmi* (WESTERGÅRD) – KOBAYASHI, p. 168. (Assigned to *Geragnostus*.)
1947 *Agnostus* (*Homagnostus*) *rudis holmi* WESTERGÅRD – WESTERGÅRD, pp. 5, 22. (Generic reference.)

Type data: – As lectotype I select the pygidium figured by WESTERGÅRD, 1922, pl. I. figs. 15a-b, from Råbäck, Kinnekulle, Västergötland, Sweden.

Remarks: – Only a single cephalon has been found in Norway.

Occurence: – Norway: Eiker (Lunde near Vestfossen). – Zone of *Peltura minor* (2dβ), subzone of *Parabolina lobata*. Associated with *Parabolina lobata* and *Peltura scarabaeoides westergårdi*. – Sweden (same subzone and the underlying subzone of *Peltura scarabaeoides*).

Genus *Glyptagnostus* WHITEHOUSE 1936

Type species: – *Glyptagnostus toreuma* WHITEHOUSE 1936 (= *Agnostus reticulatus* ANGELIN 1851, according to WESTERGÅRD, 1947, p. 6), by original designation.

Glyptagnostus reticulatus reticulatus ANGELIN 1851

Pl. 5, fig. 17.

Non-Norwegian literature before 1947 see WESTERGÅRD, 1947.
1882 *Agnostus reticulatus*, ANG. – BRÖGGER, p. 57, pl. I, figs. 11a–b. (Remarks. Figs. of cephalon and pygidium.)
1901 *Agnostus reticulatus* ANG. – MÜNSTER, p. 24. (Recorded.)
1929 *Agnostus reticulatus* ANG. – STRAND, p. 356. (Recorded.)
1947 *Glyptagnostus reticulatus* (ANGELIN) – WESTERGÅRD, p. 5, pl. I, figs. 1–6. (Remarks on species. Figs. of cephala and pygidia.)

Type data: – As lectotype I select the cephalon figured by WESTERGÅRD, 1922, pl. I, fig. 2, one of ANGELIN's cotypes from Andrarum, Scania, Sweden.

Remarks: – The few Norwegian specimens agree with the Swedish ones. The subspecies *G. reticulatus nodulosus* WESTERGÅRD 1947 has not been found in Norway.

Occurrence: – Norway: Ringerike (Hval, Viul), Ringsaker. – Zone of *Olenus* (2aβ), subzone of *Olenus gibbosus*. Alone or associated with *Olenus gibbosus*. – Sweden (same subzone and subzone of *Olenus truncatus*), Denmark (*Olenus* zone), Great Britain (Lower Lingula Flags), U.S.A. (Alabama), Canada (British Columbia), Australia (Queensland).

Family Asaphidae BURMEISTER 1843

Genus *Niobella* REED 1931

Type species: – *Niobe homfrayi* SALTER 1866, by original designation.

Niobella primaeva WESTERGÅRD 1909

Pl. 6, figs. 1–9.

1909 *Niobe primaeva* n. sp. – WESTERGÅRD, p. 52, pl. I, figs. 23, 24? (Descr. and figs. of incomplete cranidium and associated pygidium.)

?1909 *Megalaspis* n. sp. – WESTERGÅRD, p. 53, pl. I, fig. 25. (Descr. and fig. of small pygidium.)

1922 *Niobe primæva* WESTERGÅRD – WESTERGÅRD, p. 180, pl. II, figs. 23, 24?, not figs. 25–26. (Remarks. Figs. copied from WESTERGÅRD, 1909. Figs. 25–26 are of *Niobella aurora*, according to WESTERGÅRD, 1939.)

?1922 *Megalaspis* sp. – WESTERGÅRD, p. 180, pl. I, fig. 29. (Remarks. Fig. copied after WESTERGÅRD, 1909.)

1939 *Niobe* [*Niobella*?] *primaeva* WESTERGÅRD – WESTERGÅRD, p. 8. (Remarks.)

1947 *Niobella primaeva* (WGÅRD.) – WESTERGÅRD, p. 26. (Listed.)

Type data: – The type material, described by WESTERGÅRD (1909), comes from the *Acerocare* beds at Sandby, Scania, Sweden.

Remarks: – The type material of *Niobella primaeva* unfortunately is rather fragmentary. It seems probable that the present material belongs to this species, also because it occurs at the same horizon. According to WESTERGÅRD (1939, p. 8), the slightly older *Niobella*

aurora differs i.a. in having a less angulate anterior margin. Apparently the present material resembles *N. aurora* in this respect. However, the pygidium differs from that of *N. aurora* in having distinct pleural furrows.

A small cranidium (pl. 6, fig. 4) shows a glabellar node. A small pygidium (pl. 6, fig. 5) resembles somewhat a pygidium (associated with *N. primaeva*) assigned by WESTERGÅRD (1909, pl. I, fig. 25) to *Megalaspis* n. sp. Also a larval pygidium (pl. 6, fig. 6) occurs in the present material. The associated hypostomes are of the *Niobella* type. The smaller one illustrated (pl. 6, fig. 8) resembles closely that of *N. aurora*, whereas the larger (pl. 6, fig. 9) has a more pointed posterior border.

Occurence: – Norway: Oslo-Asker (Nærsnes), Nes-Hamar (Røne shale quarry). – Zone of *Acerocare* (2dε), subzone of *Acerocare ecorne*. Associated with *Acerocare ecorne*, *Parabolina acanthura*, and *Pelturina punctifera*. – Sweden (same horizon).

Family Ceratopygidae RAYMOND 1913

Genus *Proceratopyge* WALLERIUS 1895

Type species: – *P. conifrons* WALLERIUS 1895, by monotypy.

Proceratopyge nathorsti WESTERGÅRD 1922

Pl. 7, figs. 2–3.

1922 *Proceratopyge Nathorsti* n. sp. – WESTERGÅRD, p. 120, pl. 2, figs. 3–5. (Descr. and figs. of pygidia.)

1947 *Proceratopyge nathorsti* WESTERGÅRD – WESTERGÅRD, p. 10, pl. 2, figs. 2–7. (Suppl. descr. Figs. of axial shield, free cheeks, cranidium, and pygidia.)

1957b *Proceratopyge nathorsti* – HENNINGSMOEN, p. 101. (Recorded.)

Lectotype: – The pygidium figured by WESTERGÅRD, 1922, pl. 2, fig. 3, designated as holotype by WESTERGÅRD, 1947, p. 10.

Remarks: – A few more or less complete free cheeks and pygidia and a small fragment of a cranidium all agree well with this species, first described from corresponding beds in Sweden. The illustrated pygidium is especially similar to the lectotype pygidium.

Occurrence: – Norway: Ringsaker (Mælum). – Zone of *Agnostus pisiformis* (2aα). Associated with *Agnostus pisiformis* and *Olenus alpha*. – Sweden (same zone.)

Family Olenidae BURMEISTER 1843.

Plates 1–4.

Remarks: – The reader is referred to an earlier paper (HENNINGSMOEN, 1957b) for descriptions of the Upper Cambrian olenids occurring in Norway. The drawings of olenids reproduced in plates 1–4 are copied from that paper, but are here arranged according to genus.

In the same paper, the collecting data for the holotype of *Pelturina punctifera* given in the description of the species (l.c., p. 250) are incorrect; – the correct data are those in the explanation of plate 28, figure 3. Furthermore, the name *Leptoplastus crassicorne* (l.c., p. 167 a.o.) should have been *Leptoplastus crassicornis*.

BRACHIOPODA

Family Billingsellidae WALCOTT & SCHUCHERT 1908

Genus *Orusia* WALCOTT 1905

Type species: – *Anomites lenticularis* WAHLENBERG 1821, by original designation.

Orusia lenticularis (WAHLENBERG 1821)

Earlier non-Norwegian references, see WALCOTT, 1912, or POULSEN, 1923.

1857 *Atrypa lenticularis* DALM. – KJERULF, p. 92. (Listed.)

1865 *Atrypa lenticularis* DALM. – KJERULF, p. 1, p. 3 (fig. 7). (Recorded. Rough figs. of dorsal and ventral valves.)

1879 *Atrypa lenticularis* – KJERULF, pl. XIII (=VI). (Listed.)

1882 *Orthis lenticularis*, WAHLENB. – BRÖGGER, p. 48. (Remarks.)

1912 *Orusia lenticularis* (WAHLENBERG) – WALCOTT, p. 765, pl. XCVIII, figs. 1, 1a–p, 2, 2a–k, 3, 3a–b, 6, 6a–c. (Descr. and figs. showing variations.)

1923 *Orusia lenticularis*, WAHLENBERG – POULSEN, p. 55. (Remarks.)

1929 *Orusia lenticularis* (WAHLENB.) – STRAND, p. 356. (Recorded.)

1934 *Orusia lenticularis* – STØRMER, p. 333. (Listed.)

Type data: – One of WAHLENBERG's specimens from Sweden should be selected as type spesmen.

Remarks: – As discussed and illustrated by WALCOTT (1921), this species shows variations in the form of the shell and in the surface ornamentation. This is true also of the Norwegian material.

Occurrence: – Norway: Skien-Brevik (Saltboden core), Sandsvær (Sandbakk core, Gjøgrefoss), Eiker (Stablum core, Kårtveit, Krekling), Oslo (Karl Johans gate, Akersgaten, Tøyen, Gamlebyen), Modum (Fure), Ringerike (Viul, Hval), Nes-Hamar (Stange), Ringsaker (Evjevika), Østerdalen (Øksna). – Zone of *Parabolina spinulosa* (2b). Alone, or associated with *Parabolina spinulosa* ± *Protopeltura aciculata* ± *Protospongia*? sp. – Sweden (same zone), Denmark (same zone), Eastern Canada (same zone), Great Britain (Upper Lingula Flags).

Genus *Eoorthis* WALCOTT 1908

Type species: – *Orthis remnicha* WINCHELL 1886, by original designation.

Eoorthis? spp.

Pl. 7, fig. 1.

Remarks: – Three orthids possibly referable to this genus have been found at different levels in the upper part of the Upper Cambrian in Norway:

A single ventral valve, with a length of 4.7 mm and a restored width of 5.6 mm from the zone of *Peltura scarabaeoides*, lower part (2d*y*), at Slemmestad (Oslo-Asker district). It is associated with *Peltura scarabaeoides scarabaeoides*.

An impression of a tiny valve (2 mm long) from the zone of *Peltura scarabaeoides*, upper part, subzone of *Parabolina* lobata (2d*δ lob.*), from Vestfossen in Eiker. It is associated with *Peltura scarabaeoides westergårdi*.

A small ventral valve (3 mm long) from the zone of *Acerocare*, subzone of *Peltura costata* (2d*ε cost.*), from Vestfossen in Eiker. It is associated with *Peltura costata* and *Parabolina heres*.

Orthoid brachiopods are also recorded from the zone of *Peltura* in Sweden by WESTERGÅRD (1944, p. 32).

PORIFERA

Class Hyalospongea VOSMAER 1886

Order Lyssakida ZITTEL 1877

Family Protospongiidae HINDE 1887

Genus *Protospongia* SALTER 1864

Type species: – Protospongia fenestrata SALTER 1864.

Protospongia? sp.

Pl. 7, figs. 4–6.

1929 *Protospongia fenestrata* SALTER – STRAND, p. 356. (Remarks.)

Material: – The material consists of a great number of isolated spicules, preserved as calcite in bituminous limestone.

Description: – The spicules are pentacts with 4 rays forming a cross and the 5th ray normal to these at their junction. The four rays are slightly curved towards the side of the shaft ray, giving the spicule a somewhat umbrella-like shape. The rays are round, very slender, and decrease slowly in size distally, but are somewhat swollen at their junction. The rays reach a length of at least 10 mm. The shaft ray appears to be as long as the others.

Discussion: – The spicules are of some interest because pentacts have not heretofore been known in protospongiids. Thus DE LAUBENFELS (1955, p. E68) remarks that "seemingly, pentact and hexact spicules had not yet evolved". Apparently the present spicules belong to a new species, probably also to a new genus. However, as long as the shape of the skeleton is not known, it seems better not to erect any new names.

Occurrence: – Norway: Ringsaker (Evjevika, Steinsodden). – Zone of *Parabolina spinulosa* (2b). Alone, or associated with *Parabolina spinulosa* and *Orusia lenticularis*.

Table 1. INVERTEBRATE FOSSILS IN THE OLENID SERIES IN NORWAY, STRATIGRAPHICALLY ARRANGED

Zones	Sub-zones	Fossils
Acerocare 2dε	ecor.	Parabolina acanthura, Acerocare ecorne, Pelturina punctifera, Niobella primaeva
	West.	Par. heres lata, Westergårdia intermedia, W. lata, W. scanica, Pelturina punctifera
	cost.	Par. heres heres, Pelture costata, Eoorthis ? sp.
	trans.	Par. heres heres, Pelt. transiens, ?Acerocarina micropyga
Peltura scarabaeoides 2dγ-δ	parad.	Par. megalops, Pelt. paradoxa, ?Acerocarina granulata
	lob.	Par. lobata lobata, Par. lobata praecurrens, Pelt. scarabaeoides westergårdi, Agn. rudis holmi, Eoorthis ? sp.
	linn.	Ctenopyge linnarssoni, Ct. fletcheri, Ct. pecten, Sph. humilis, Sph. majusculus, Pelt. scar. scarabaeoides
	bis.	Ct. bisulcata, Sphaerophthalmus humilis, Sph. majusculus, Peltura scarabaeoides scarabaeoides, ?Eoorthis ? sp.
Peltura minor 2dβ	aff.	Ct. affinis affinis, Ct. affinis gracilis, Sphaerophthalmus alatus, Peltura minor
	tum.	Ct. tumida, Sph. alatus, Protopeltura planicauda, Peltura minor, Peltura acutidens
	spect.	Ct. spectabilis, Ct. tumidoides, Ct. angusta
	sim.	Parabolina mobergi, Ctenopyge modesta, Ct. erecta, Protopeltura bidentata

Table 1, cont.

Zones	Sub-zones	Fossils	
Protopeltura praecursor 2dα	flag.	Ctenopyge flagellifera, Ct. drytonensis, Protopeltura praecursor	
	postc.	Ctenopyge postcurrens, Protopeltura praecursor	
	negl.	Leptoplastus neglectus, Protopeltura praecursor	
	?holt.	Protopeltura holtedahli	
	?broeg.	Protopeltura broeggeri	
Leptoplastus 2c	sten.	Leptoplastus stenotus	
	ang.	Leptoplastus angustatus, Eurycare latum	
	ovat.	Leptoplastus ovatus, L. crassicornis var., Eurycare explanatum, E. latum, E. brevicauda	
	crass.	Leptoplastus crassicornis, L. norvegicus	
	raph.	Leptoplastus raphidophorus	
Parabolina spinulosa 2 b	spin.	Parabolina spinulosa, Protopeltura aciculata pusilla, Orusia lentic. Protospongia? sp.	
	brev.	Parabolina brevispina, Orusia lenticularis	
Olenus & Agnostus obesus 2aβ	att.	Olenus attenuatus, Agnostus obesus	? in front of a name indicates, that the exact horizon is uncertain.
	wahl.	Olenus wahlenbergi, Agnostus obesus	
	trunc.	Olenus truncatus, Agnostus obesus, ?Glyptagnostus reticulat.	
	gibb.	Olenus gibbosus, O. transversus, Agnostus obesus	
Agnostus pisiformis 2aα		Olenus alpha, Agnostus pisiformis, Proceratopyge nathorsti	

Table 2. STRATIGRAPHIC AND GEOGRAPHIC OCCURENCE OF INVERTEBRATE FOSSILS IN THE OLENID SERIES IN NORWAY

Fossils	Horizon	Districts									
		Skien-Brevik	Eiker-Sandsvær	Oslo-Asker	Modum	Ringerike	Hadeland	Hamar	Ringsaker	Valdres-Vardal	Østerdalen
Trilobitae											
Olenidae											
Olenus alpha	2aα	—	—	—	—	—	—	—	+	—	—
« attenutatus	2aβ att.	—	+	+	—	—	—	—	—	—	—
« gibbosus	2aβ gibb.	+	+	—	—	+	—	—	+	+	+
« transversus	2aβ gibb.	—	—	—	—	—	—	—	+	—	+
« truncatus	2aβ trunc.	—	—	—	—	+	—	—	+	+	—
« wahlenbergi	2aβ wahl.	—	—	+	—	—	—	—	+	—	—
Parabolina acanthura	2dε ecor.	—	+	+	—	—	—	—	—	—	—
« brevispina	2b brev.	—	—	+	—	—	—	—	—	—	—
« heres heres	2dε cost.-trans.	—	+	+	—	—	—	—	+	—	—
« heres lata	2dε West.	—	—	+	—	—	—	—	—	—	—
« lobata lobata	2dδ lob.	—	+	—	—	—	—	+	—	—	—
« lobata praecurrens	2dδ lob.	—	—	+	—	—	—	—	—	—	—
« megalops	2dδ parad.	—	—	—	+	—	—	—	?	—	—
« mobergi	2dβ sim.	—	—	+	—	—	+	—	—	—	—
« spinulosa	2b spin.	+	+	+	+	+	+	—	+	—	+
Leptoplastus angustatus	2c ang.	—	+	+	+	—	—	+	+	—	—
« crassicornis	2c crass.	—	+	+	—	—	—	+	+	—	—
« crassicornis var.	2c ovat.	—	—	—	—	—	—	+	—	—	—
« neglectus	2dα negl.	—	+	+	—	—	—	—	—	—	—
« norvegicus	2c crass.	—	+	+	—	—	—	+	+	—	—
« ovatus	2c ovat.	—	+	+	—	+	—	+	+	+	—
« raphidophorus	2c raph.	—	—	+	—	—	—	+	—	—	—
« stenotus	2c sten.	—	—	+	—	—	—	—	—	—	—
Eurycare brevicauda	2c ovat.	—	+	+	—	—	—	—	—	—	—
« explanatum	2c ovat.	—	+	—	—	—	—	+	+	—	—
« latum	2c ovat.-ang.	—	+	+	+	—	—	+	+	—	—
Ctenopyge (Eoct.) angusta	2dβ spect.	—	—	+	—	—	—	—	—	—	—
« drytonensis	2dα flag.	—	—	+	—	—	—	—	—	—	—
« « flagellifera	2dα flag.	+	+	+	—	—	—	—	—	—	—
« « modesta	2dβ sim.	—	—	+	—	—	—	—	—	—	—
« « postcurrens	2dα postc.	—	—	+	—	—	—	+	—	—	—
« (Mesoct.) erecta	2dβ sim.	—	—	+	—	—	—	—	—	—	—
« « similis	2dβ sim.	—	—	+	—	+	—	—	—	—	—

Table 2, cont.

Fossils	Horizon	Districts									
		Skien-Brevik	Eiker-Sandsvær	Oslo-Asker	Modum	Ringerike	Hadeland	Hamar	Ringsaker	Valdres-Vardal	Østerdalen
Ctenopyge (Mesoct.) spectabilis	2dβ spect.	—	—	+	—	—	—	—	+	—	—
« « tumida	2dβ tum.	—	—	+	—	—	+	—	—	—	—
« « tumidoides	2dβ spect.	—	—	+	—	—	—	—	+	—	—
« (Ct.) affinis affinis	2dβ aff.	—	—	+	—	—	—	—	—	—	—
« « affinis gracilis	2dβ aff.	—	—	+	—	—	—	—	+	—	—
« « bisulcata	2dγ bis.	—	—	—	+	—	—	—	—	—	—
« « fletcheri	2dγ linn.	—	—	+	—	+	—	—	—	—	—
« « linnarssoni	2dγ linn.	—	—	+	—	—	—	—	—	—	—
« « pecten	2dγ linn.	—	+	—	—	+	—	—	—	—	—
Sphaerophthalmus alatus	2dβ tum.-aff.	+	+	+	+	+	+	—	+	+	—
« humilis	2dγ bis.-linn.	+	+	+	+	+	+	+	+	+	+
« majusculus	2dγ bis.-linn.	—	—	+	+	+	—	+	+	+	—
Protopeltura aciculata pusilla	2b spin.	—	+	+	—	+	+	—	—	—	—
« bidentata	2dβ sim.	—	—	+	—	—	—	—	—	—	—
« broeggeri	2dα broeg.	—	+	+	—	—	—	—	—	—	—
« holtedahli	2dα holt.	—	—	+	—	—	—	—	—	—	—
« planicauda	2dβ tum.	—	—	+	—	—	—	—	—	—	—
« praecursor	2dα negl.-flag.	+	+	+	—	—	—	—	—	—	—
Peltura acutidens	2dβ tum.	—	—	+	—	—	—	—	+	—	—
« costata	2dε cost.	—	+	+	—	—	—	—	+	—	—
« minor	2dβ tum.-aff.	—	+	+	—	+	—	—	—	+	—
« paradoxa	2dδ parad.	—	—	—	+	—	—	—	—	—	—
« scarabaeoides scarabaeoides	2dγ bis.-linn.	+	+	+	+	+	+	+	+	+	+
« scarabaeoides westergårdi	2dδ lob.	—	+	+	—	—	—	—	—	—	—
« transiens	2dε trans.	—	+	+	—	—	—	—	—	—	—
Acerocare ecorne	2dε ecor.	—	—	+	—	—	—	—	—	—	—
Pelturina punctifera	2dε West.-ecor.	—	—	+	—	—	—	—	—	—	—
Acerocarina granulata	2dδ parad.?	—	+	—	—	—	—	—	—	—	—
« micropyga	2dε trans.?	—	—	+	—	—	—	—	—	—	—
Westergårdia intermedia	2dε West.	—	—	+	—	—	—	—	—	—	—
« lata	2dε West.	—	—	+	—	—	—	—	+	—	—
« scanica	2dε West.	—	—	+	—	—	—	—	—	—	—

Table 2, cont.

Fossils	Horizon	District									
		Skien-Brevik	Eiker-Sandsvær	Oslo-Asker	Modum	Ringerike	Hadeland	Hamar	Ringsaker	Valdres-Vardal	Østerdalen
Agnostidae											
Agnostus (Agnostus) pisiformis	2aα	+	+	+	—	+	—	+	+	+	+
« (Homagnostus) obesus	2aβ gibb.-att.	+	+	+	—	+	—	+	+	+	+
« « rudis holmi	2dδ lob.	—	+	—	—	—	—	—	—	—	—
Glyptagnostus reticulatus	2aβ trunc.?	—	—	—	—	+	—	—	+	—	—
Asaphidae											
Niobella primaeva	2dε ecor.	—	—	+	—	—	—	+	—	—	—
Ceratopygidae											
Proceratopyge nathorsti	2aα	—	—	—	—	—	—	—	+	—	—
Brachiopoda											
Eoorthis? sp.	2dε cost.	—	+	—	—	—	—	—	—	—	—
Eoorthis? sp.	2dδ lob.	—	+	—	—	—	—	—	—	—	—
Eoorthis? sp.	2dγ	—	—	+	—	—	—	—	—	—	—
Orusia lenticularis	2b brev.-spin.	+	+	+	+	+	—	+	+	—	+
Porifera											
Protospongia? sp.	2b spin.	—	—	—	—	—	—	—	+	—	—

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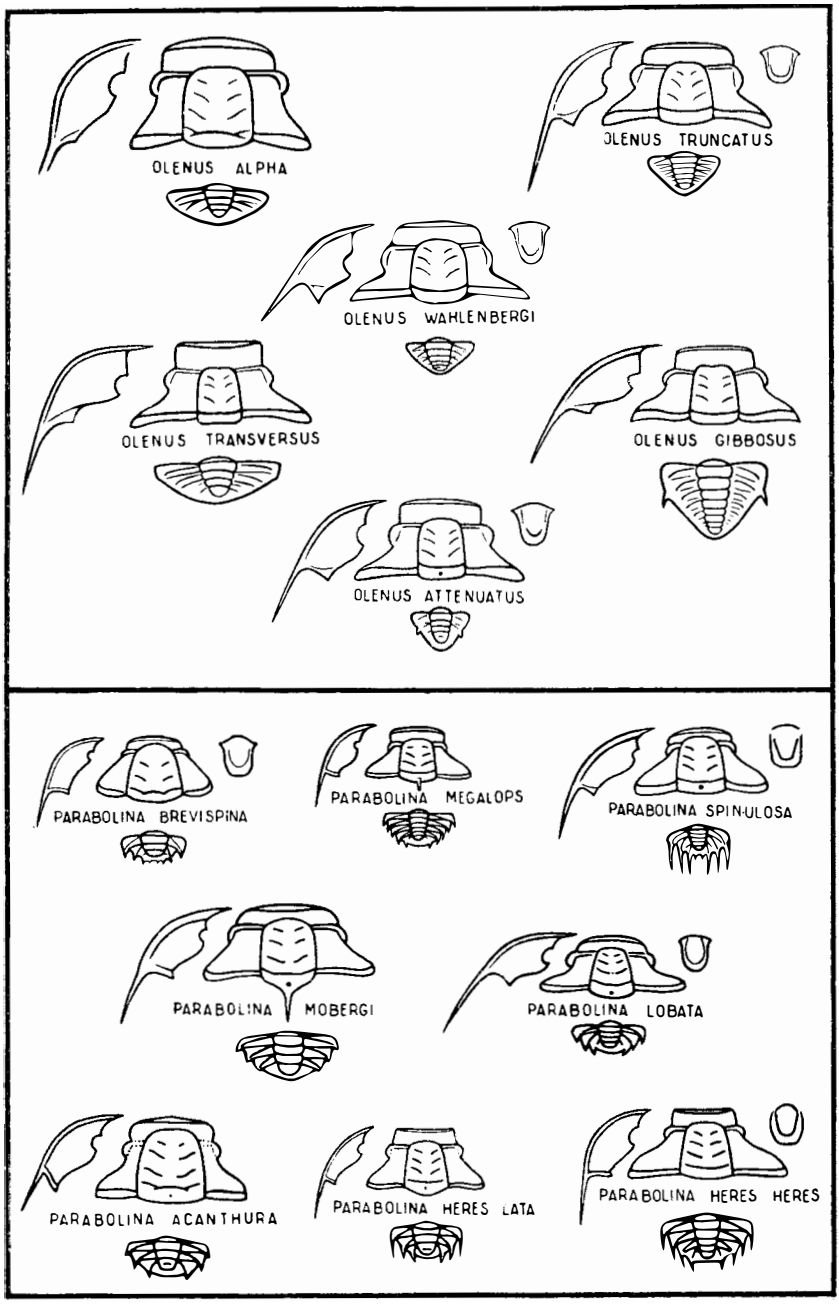
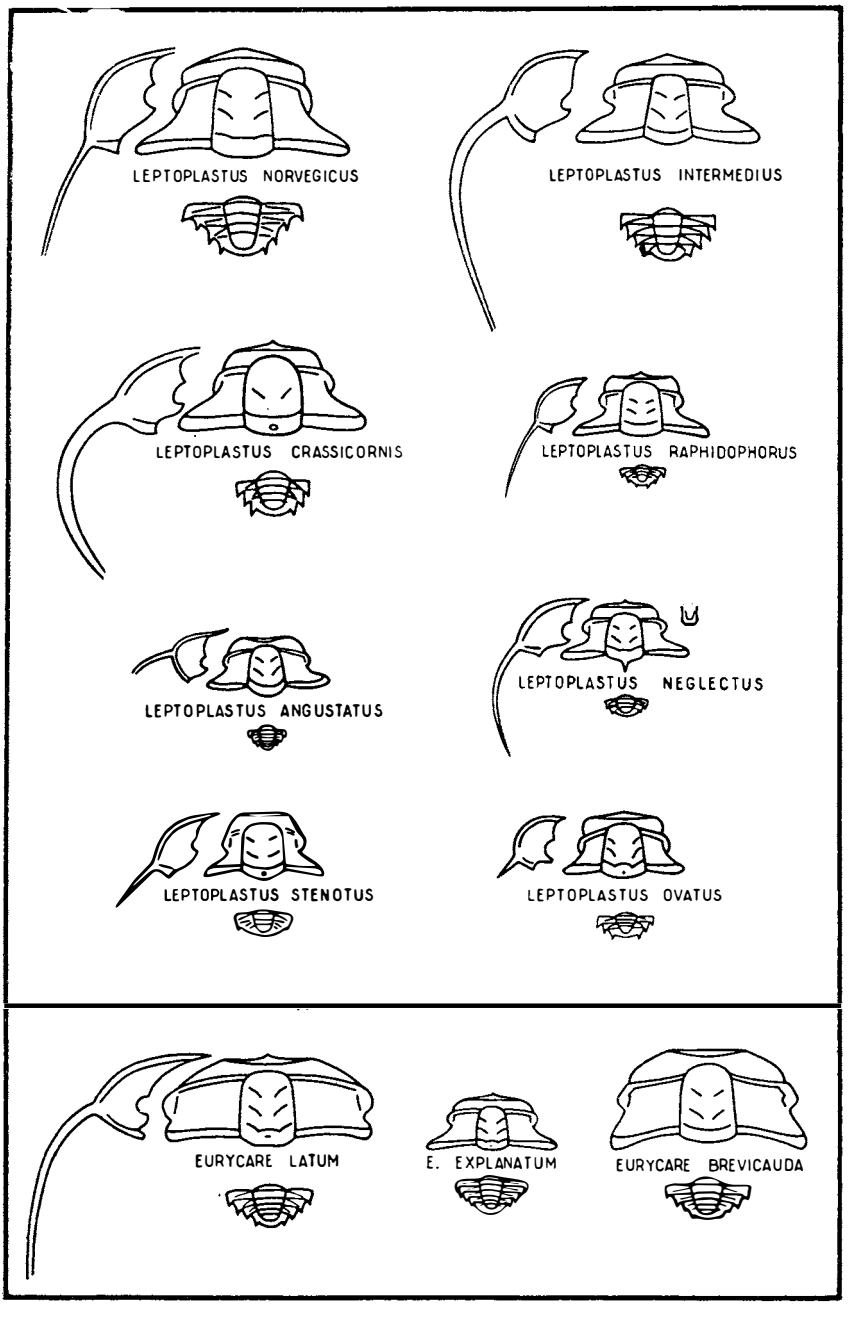
PLATES 1—7

PLATE 1

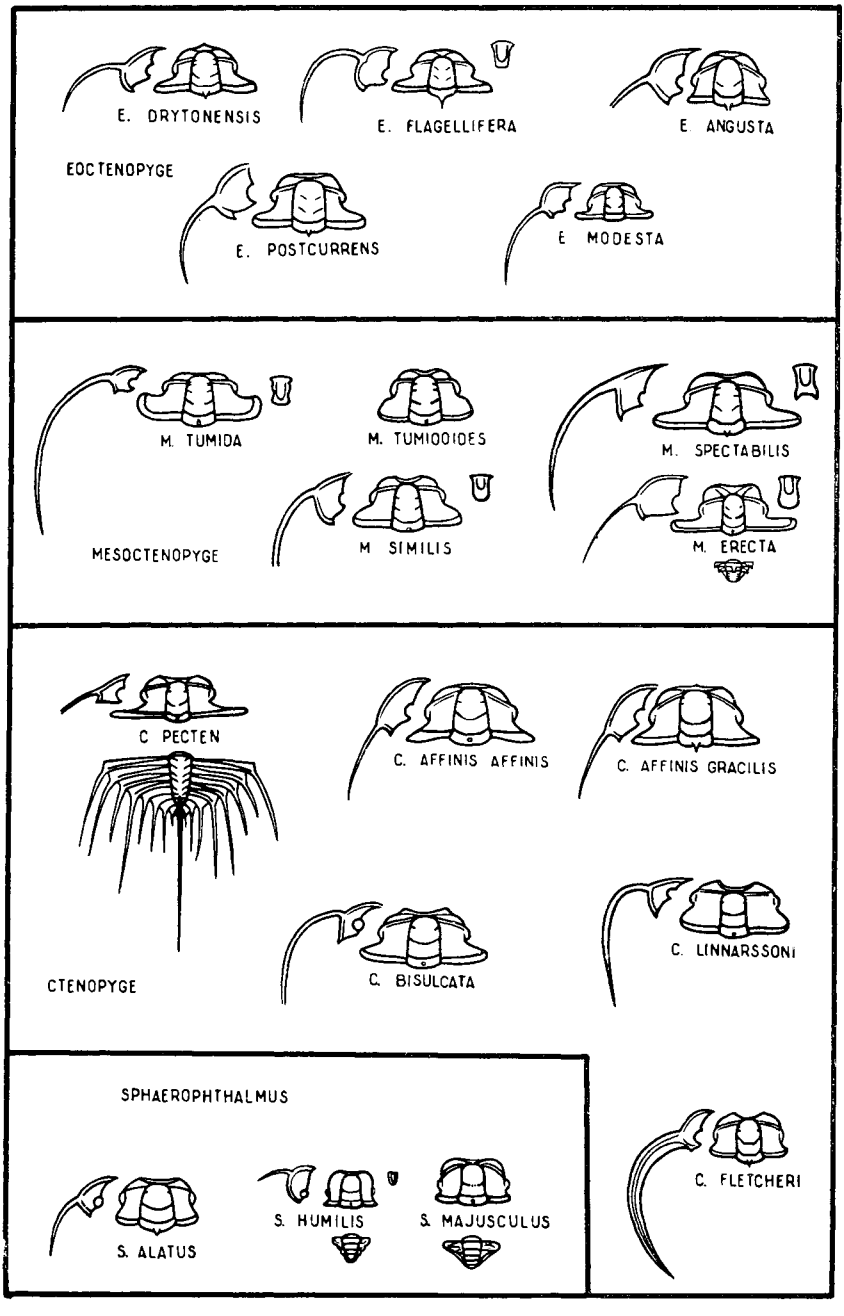


Olenidae; Oleninae. (C. x 2)



Olenidae; Leptoplastinae 1. (C. x 2)

PLATE 3



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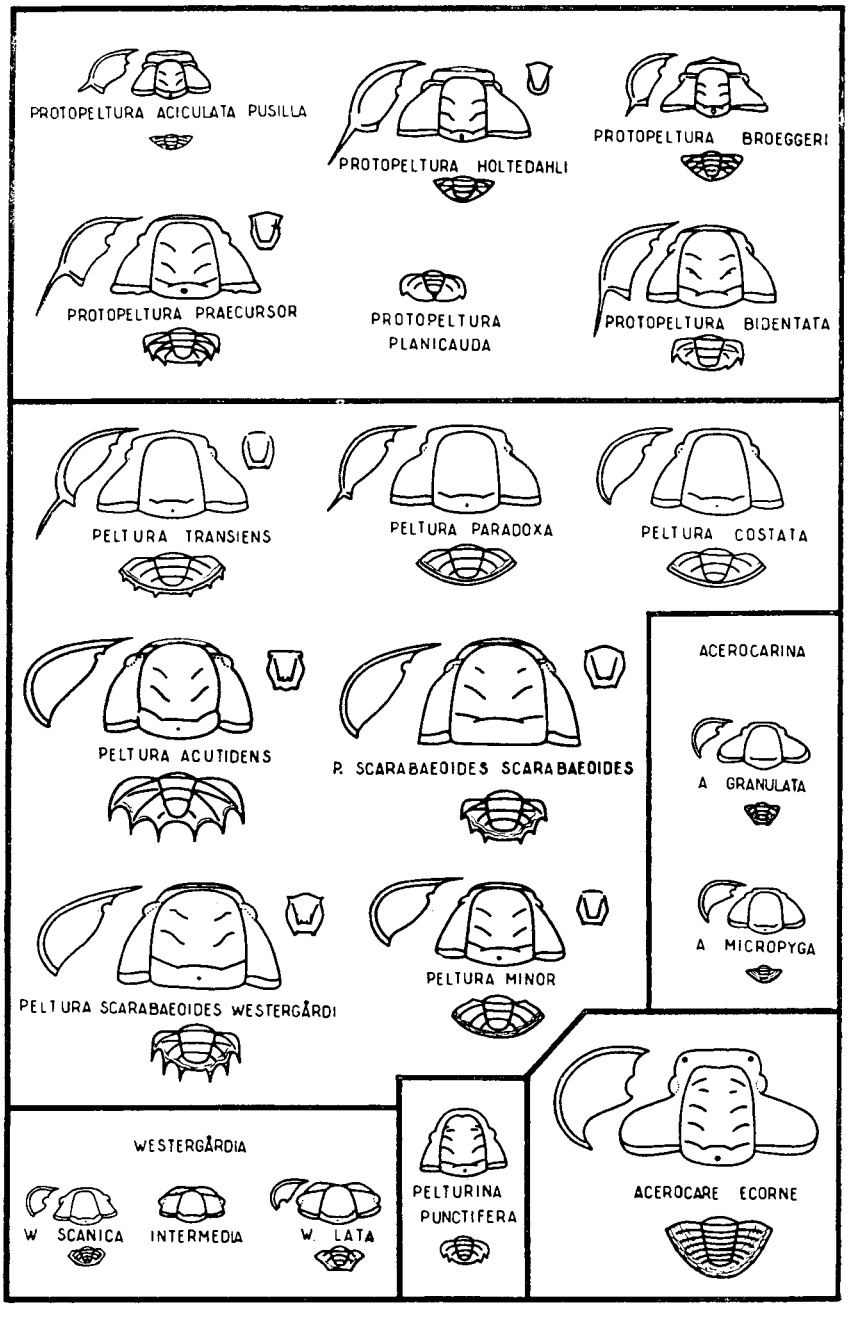


Olenidae; Pelturinae. (C. x 2)

PLATE 5

The photographs are not retouched. The specimens were whitened with ammonium chloride.

All x 6.6

Agnostus (*Agnostus*) *pisiformis* LINNÆUS 1757 – p. 181

2a*α*. Mælum, Ringsaker. Coll.: S. Skjeseth, 1949.

Fig. 1. Well-sized smooth cephalon (P.M.O. no. 66765).
Fig. 2. Well-sized smooth pygidium (P.M.O. no. 66763).

2a*α*. Skårås, Valset, Nes-Hamar. Coll.: S. Skjeseth, 1950.

Fig. 3. Smooth cephalon (P.M.O. no. 67761a), showing well the posterior border.
Fig. 9. Smooth pygidium (P.M.O. no. 67761d), showing well the marginal spines.
Fig. 10. Smooth pygidium (P.M.O. no. 67761b).
Fig. 11. Thoracic segment (P.M.O. no. 67761c).

2a*α*. Stensrudbekken, just east of Stensrudtjernet, Nes-Hamar. Coll. S. Skjeseth, 1950.

Fig. 4. Cephalon (P.M.O. no. 67864b) with grooved cheeks.
Fig. 5. Cephalon (P.M.O. no. 67864a) with almost smooth cheeks.
Fig. 6. Cephalon (P.M.O. no. 67854a) with faintly grooved cheeks.
Fig. 7. Small pygidium (P.M.O. no. 67864d) with reticulated pleural areas.
Fig. 8. Small pygidium (P.M.O. no. 67854b) with reticulated pleural areas.
Fig. 12. Larval cephalon (P.M.O. no. 67864c) with grooved cheeks.

Agnostus (*Homagnostus*) *obesus* BELT 1867 – p. 182

2a*β*. The alum shale quarry, Gamlebyen, Oslo. Old collection.

Fig. 13. Cephalon (P.M.O. no. 61458a).
Fig. 14. Pygidium (P.M.O. no. 61458b).

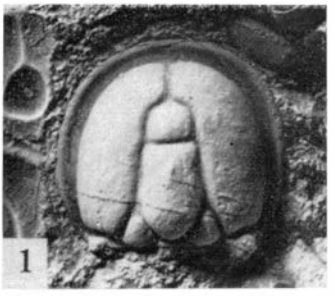
Trolmen, Västergötland, Sweden (for comparison). Coll.: G. Henningsmoen, 1956. Zone of *Olenus*, subzone of *Olenus gibbosus*.

Fig. 15. Cephalon (P.M.O. no. A 27157).
Fig. 16. Pygidium (P.M.O. no. A 27158).

Glyptagnostus reticulatus reticulatus ANGELIN 1851 – p. 184

2a*β*. Ringsaker. Coll. Th. Münster, 1879.

Fig. 17. Pygidium (P.M.O. no. 30214). Figured by BRÖGGER, 1882, pl. I, fig. 11b.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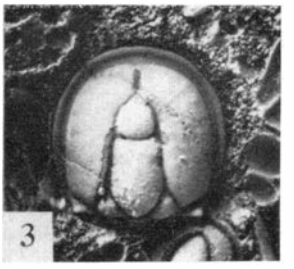
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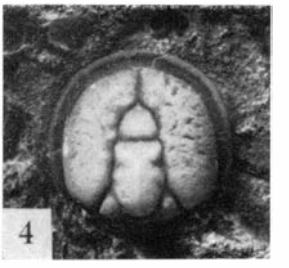
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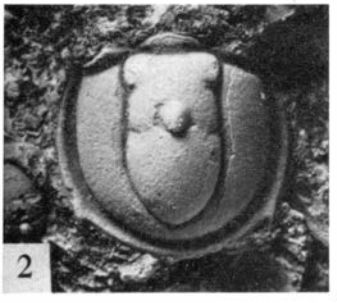
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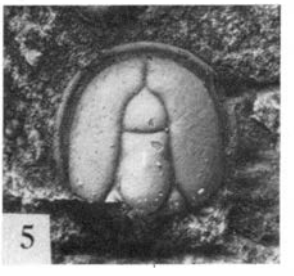
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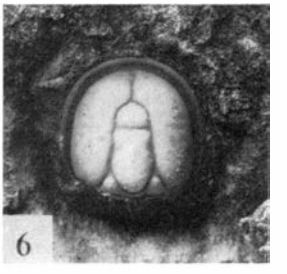
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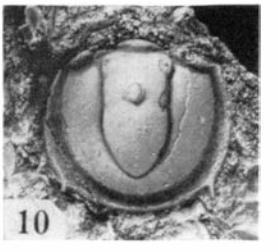
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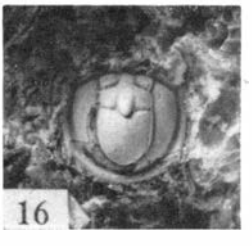
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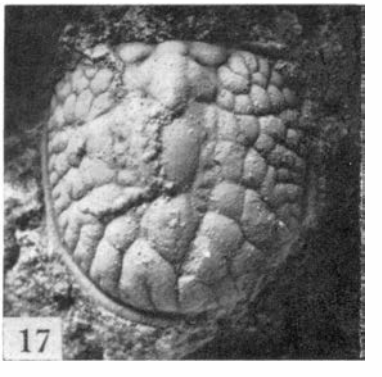

17

PLATE 6

The photographs are not retouched. The specimens were whitened with ammonium chloride.

Niobella? primaeva WESTERGÅRD 1909 – p. 185

2dε. Røne shale quarry, Løyten, Nes-Hamar. Coll.: S Skjeseth, 1954.

Fig. 1. x 3.6 Pygidium (P.M.O. no. 69312).

2dε. Beach at Nærsnes gård, Røyken, Oslo-Asker. Coll.: G. Henningsmoen and N. Spjeldnæs, 1954.

Fig. 2. x 3.3. Frontal part of cranidium (P.M.O. no. 69319)

Fig. 3. x 3.3 Pygidium. Latex cast of P.M.O. no. 69320.

Fig. 4. x 6.6 Small cranidium. Latex cast of P.M.O. no. 69321.

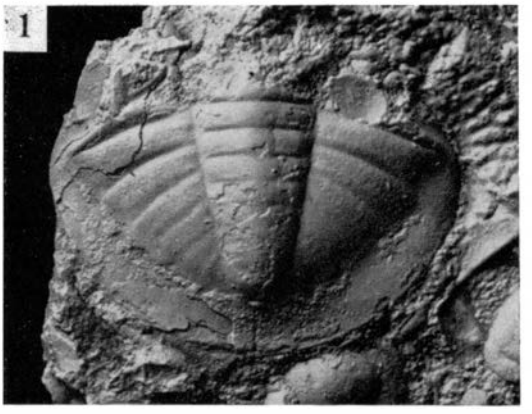
Fig. 5. x 6.6 Small pygidium (P.M.O. no. 69322).

Fig. 6. x 6.6 Larval pygidium (P.M.O. no. 69323).

Fig. 7. x 6.6 Pleuron (P.M.O. no. 69324) (Light from below).

Fig. 8. x 6.6 Small hypostome (P.M.O. no. 69318a).

Fig. 9. x 6.6 Hypostome (P.M.O. no. 69318b).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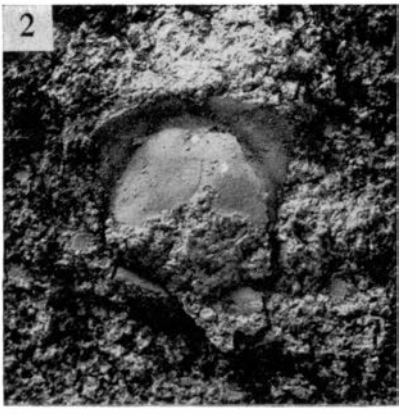
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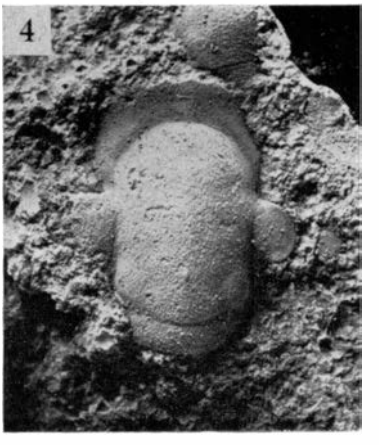
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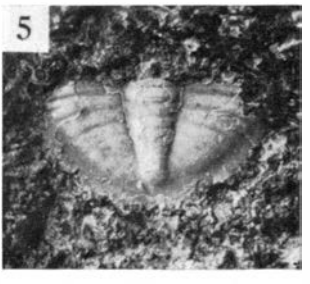
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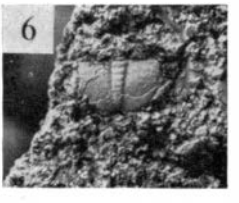
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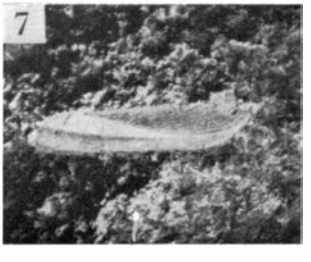
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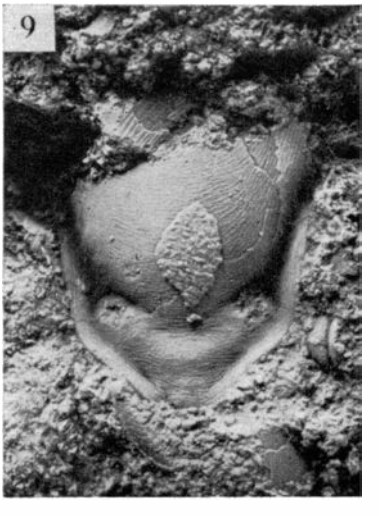
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PLATE 7

The photographs are not retouched. The specimens were whitened with ammonium chloride.

Eoorthis? sp. – p. 188

2dγ. Beach north of Slemmestad, Røyken, Oslo-Asker. Coll.: T. Strand, 1928.

Fig. 1. x 6.6 P.M.O. no. 29550.

Proceratopyge nathorsti WESTERGÅRD 1922 – p. 186

2aα. Mælum, Ringsaker.

Fig. 2. x 6.3 Pygidium (P.M.O. no. 66763). Coll.: S. Skjeseth, 1949.

Fig. 3. x 6.3 Free cheek (P.M.O. no. 30249). Coll.: W. C. Brögger.

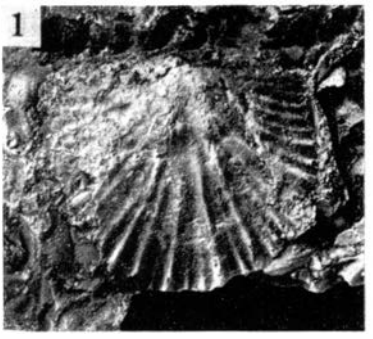
Protospongia? sp. – p. 189

2b *spin.* Steinsodden, Ringsaker. Coll.: S. Skjeseth, 1949.

Fig. 4. x 13.2 To the left a spicule seen from the shaft side (P.M.O. no. 69325a). Only the base of the shaft ray is present. To the right another spicule (69325b) seen from the other end. The proximal parts of the four rays are missing, thus revealing where the shaft ray penetrates the rock.

Fig. 5. x 13.2 Spicule (69325c) seen from shaft-less end.

Fig. 6. x 13.2 Spicule (69325d) seen from the shaft side. Only the base of the shaft is preserved.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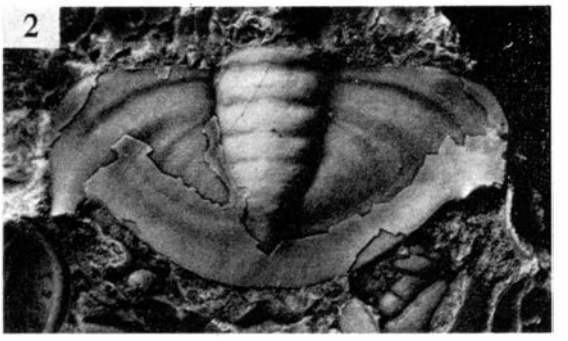
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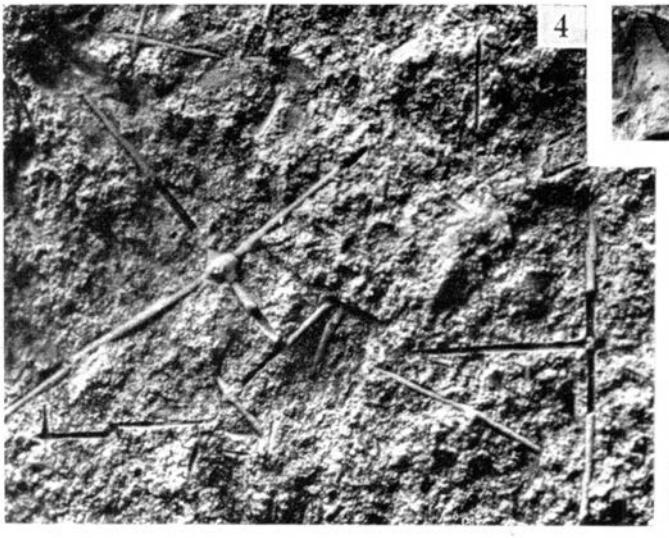
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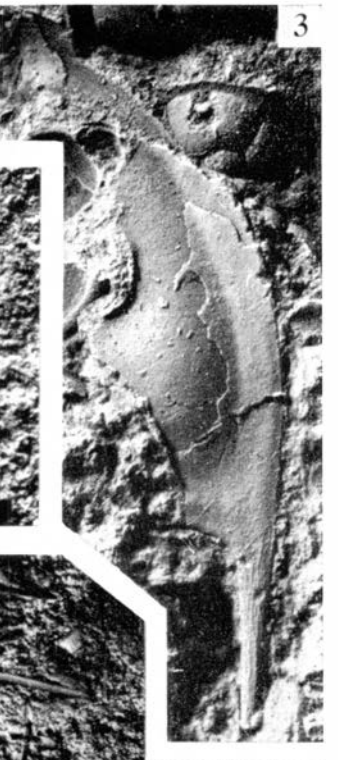
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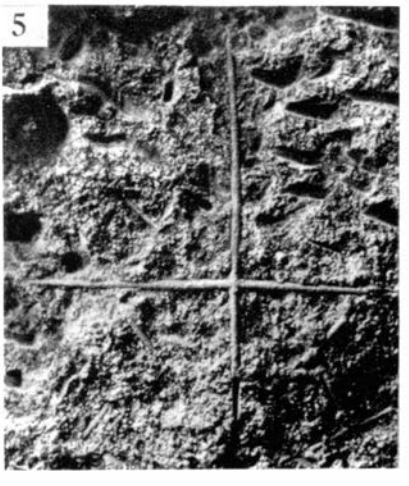
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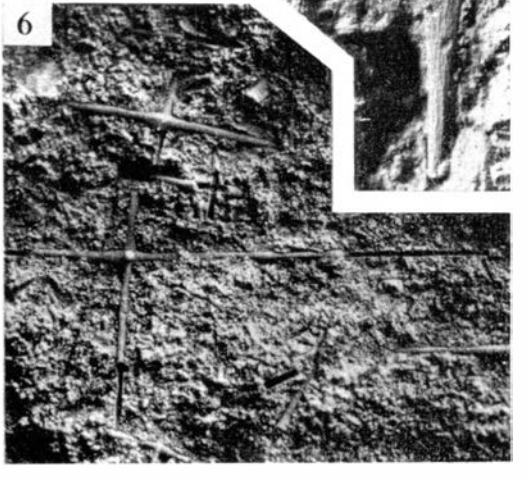
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